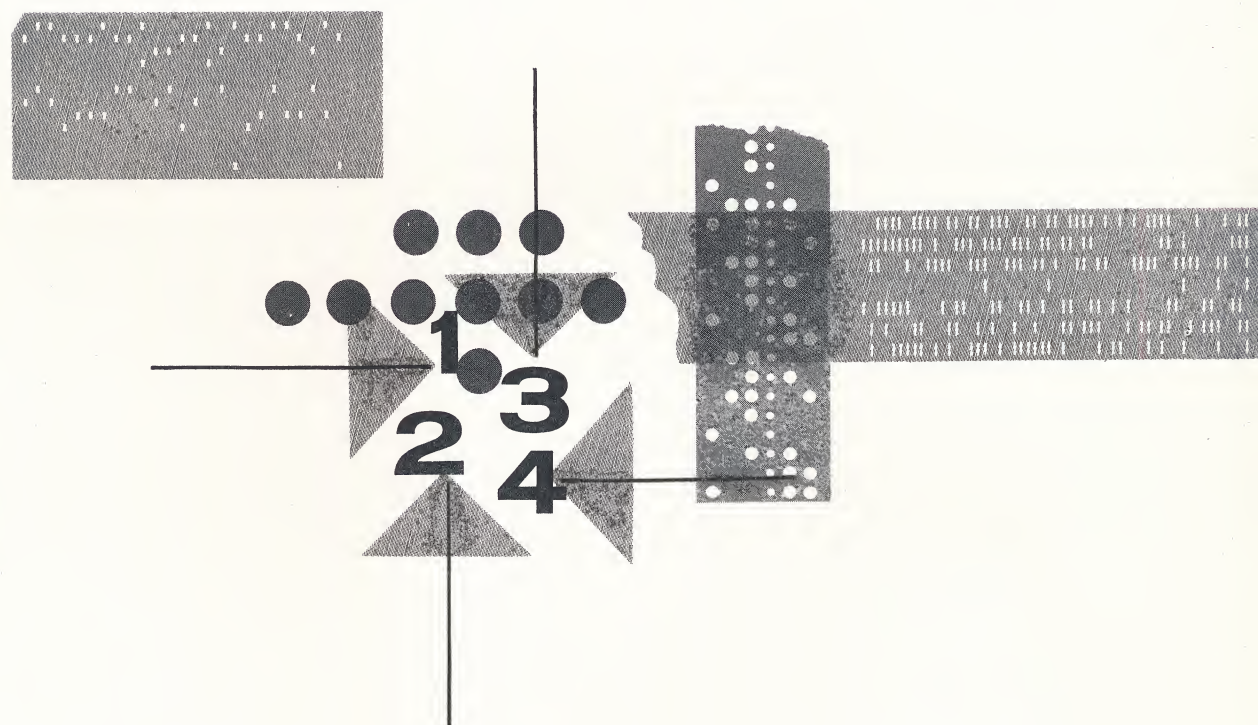


Basic Automation Services



MCDONNELL AUTOMATION CENTER

SERVES

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BASIC FUNC

Effective automation results from the successful application of the four fundamental principles of Consulting, Systems Design, Programming, and Data Processing.

CONSULTING determines if and where automation is justified, and how it can best be applied.

SYSTEMS DESIGN creates plans for the most efficient use of the latest procedures and equipment.

PROGRAMMING translates these plans into languages the computers can understand, and assures the proper link between planning and processing.

DATA PROCESSING puts the computing equipment to work to provide the answers sought, and serves a one time need or a continuing requirement.

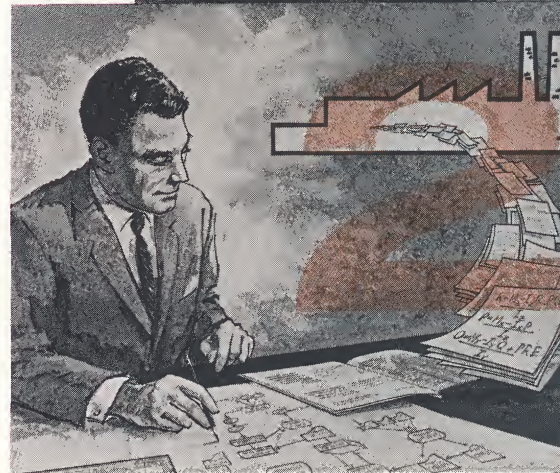
They form an interconnected sequence of functions, inviolable in order and importance.

CONSULTING An effective automation system removes the energy-consuming drudgery of routine, repetitive tasks and releases energy for non-repetitive, creative tasks. But this cannot be accomplished without first planning a course of action and then developing a system for programming that action.

Effective automation begins with consultation with specialists, to help you discover possible bottlenecks in your operation. You will not turn the job completely over to them. They will want you to work with them as a team, for only your counsel can help them retain the characteristics that give your firm its individuality. Together you will determine if automation is justified. This is why you should choose consultants experienced in all phases of automation techniques. Some situations may require only simple changes in clerical procedures, or the use of simple bookkeeping machines, adding machines, or desk calculators. Other situations may require high-speed, electronic computers and data processing machines.

The effective uses of automation do not just happen. Diligent planning, careful study, and wise counsel eliminate the risk of unnecessary expense or disruptive adjustment of procedures and personnel. McDonnell Automation Center consultants do not sell computing equipment, only guidance and assistance based on knowledge.

SYSTEMS DESIGN Systems analysts plan the program you and the consultants decide is best for your organization. This could mean simply reassigning present personnel to new or more actively responsible jobs, rechanneling an existing flow of reports, analyses, and information, or the application of completely new procedures and techniques. If you and the consultants decide that



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your operation can benefit from electronic data handling, processing, or computing, systems personnel will create the detailed plan necessary to activate your decision.

Automation Center systems analysts are qualified to design working systems for the simplest or the most complex operations. They will carefully schedule procedural changes so that your daily operations can continue without abrupt administrative shifts, or so that changes may be applied parallel to existing operations and tested to locate and close any loopholes that might occur. The best method of improving your company's operation will be established only after a careful analysis of all the pertinent data. They will alter only as necessary to increase the efficiency of your operation.

System designs are individually tailored to fit each new application. To insure maximum benefits from their designs, systems analysts must be experienced in a wide area of automation applications. With their assistance you can confidently automate your operation for a maximum of output and efficiency, with a minimum of time and expense.

PROGRAMMING Programming is the link between the system design and the necessary data handling equipment which produces the results. Without precise instructions from a programmer, the capabilities of high-speed, electronic computing machines cannot be fully utilized.

An enormous amount of preplanning goes into even the simplest work done by a computer, for it has to be told in extreme detail what to do. A programmer must write a sequence of instructions for the computer to execute, much as a composer creates notes of music for an orchestra to play. Machines

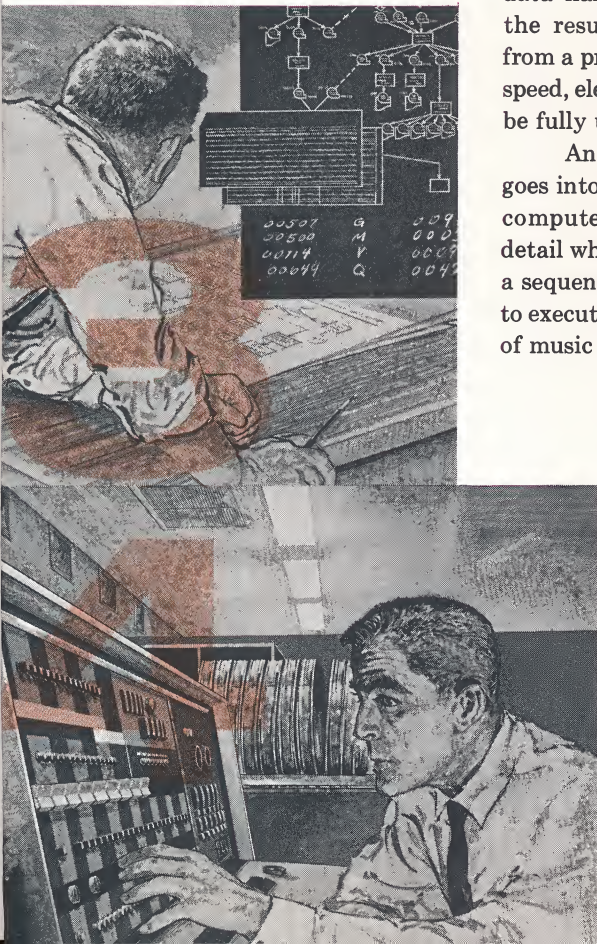
react to signals in much the same way humans do, except that unlike human responses in the same environment the same signal will always bring the same response from the machine. A computer interprets everything absolutely literally. A computing language is primarily a command language used for issuing instructions, signals which trigger preconditioned responses stored in the machine memory.

What makes an Automation Center programmer valuable is his ability to make the machine perform with peak accuracy and efficiency the multiple assignments it must accomplish.

DATA PROCESSING Data processing and computing, of course, is the step toward which the consulting, systems design, and programming functions have led, the final function of the four basic activities which, together, comprise an efficient automation program.

Effectiveness with efficiency in data processing presumes the proper use of a multiplicity of electronic computing machines to process data and information to solve specific problems. The greater the variety of equipment, the greater the variety of problems that can be solved, because programs can be directed to machines designed for the type of problem they are best suited to solve.

The Automation Center's data processing, handling, and computing equipment encompasses virtually every size and type available, conveniently located and organized to serve the one-time need or the most comprehensive, continuing data processing program, for any size company, large or small. This variety of machines enables the Center to process any size or type of program at the lowest possible hourly rates, because a customer is not bound to a single machine. Programs go to the machine designed to process a particular type of problem. Because of their high speed, they offer a low unit cost. The Automation Center handles large or small data processing programs at rates often lower than the cost of small home-owned computers.



To find out how one or all of these services can be put to work for you, effectively, contact the

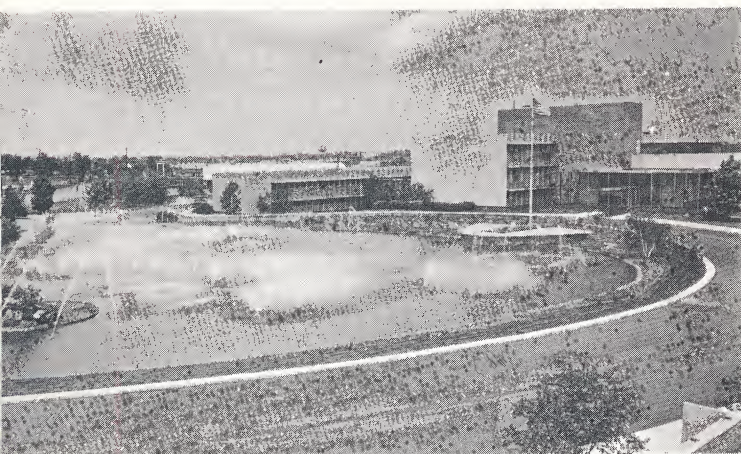
MCDONNELL AUTOMATION CENTER.

Personnel

Experience

Equipment

The McDonnell Automation Center has a large staff of experienced consultants, systems analysts, programmers, and data processing specialists. Our services have been employed by clients of every size in many industries throughout the United States. The Center's creative and analytical capabilities are based on over two decades of data processing experience. The multi-million dollar inventory of computing and data handling equipment available for client use ranges from punched card processors and small calculators to giant digital and analog computers. The McDonnell Automation Center has the personnel, experience, and equipment to solve your technical and administrative problems.



Applications (Administrative)

Accounting
Manufacturing
MICR Demand Deposit Accounting
Grade Reporting
School Scheduling
Payroll
Statistical Analysis
Advertising Research

Applications (Scientific)

Mathematical Programming
Numerical Control
Reliability Studies
Test Data Reduction
Stress Analysis
Linear Programming
Trajectories
Circuit Design and Analysis
Operations Research
Stochastic Simulation
Network Analysis
Framed Structures Analysis
Piping Flexibility Analysis
Load Flow Analysis

Industries

Accounting, Auditing, & Bookkeeping
Aerospace
Wholesale & Retail
Chemical
Metal Fabricating
Construction
Data Processing
Finance
Government
Manufacturing
Insurance
Education
Real Estate
Transportation
Investment & Brokerage
Publishing
Petroleum
Public Utilities



MCDONNELL AUTOMATION CENTER

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PERSHING 1-2121
BOX 516 ST. LOUIS, MISSOURI 63166

25 June 1965

Mr. Ted Nelson
Systems Cons.
Box 32
Schooleys Mountain, New Jersey

Dear Mr. Nelson:

We are pleased to enclose our brochure, "Linear Programming", which you have requested. These linear programming systems are now being used for corporate models involving more than two thousand restraints and several thousand variables. Some of these models, in addition to using the decomposition technique, include separable linear programming which allows the inclusion of non-linear functions. Another valuable part of these new linear programming systems is the analysis report writer which facilitates the interpretation of large problems for management.

We have also included a brochure describing in general terms other services offered by our organization. In addition to the variety of equipment available, we are also able to provide personnel who are highly trained in such fields as administrative systems analysis, digital programming, applied mathematics, physics and general engineering, and business problems.

If we may be of service to you at any time, or should you require further information, do not hesitate to contact us at Area Code 314, PERSHING 1-2121, Extension 3418.

Very truly yours,

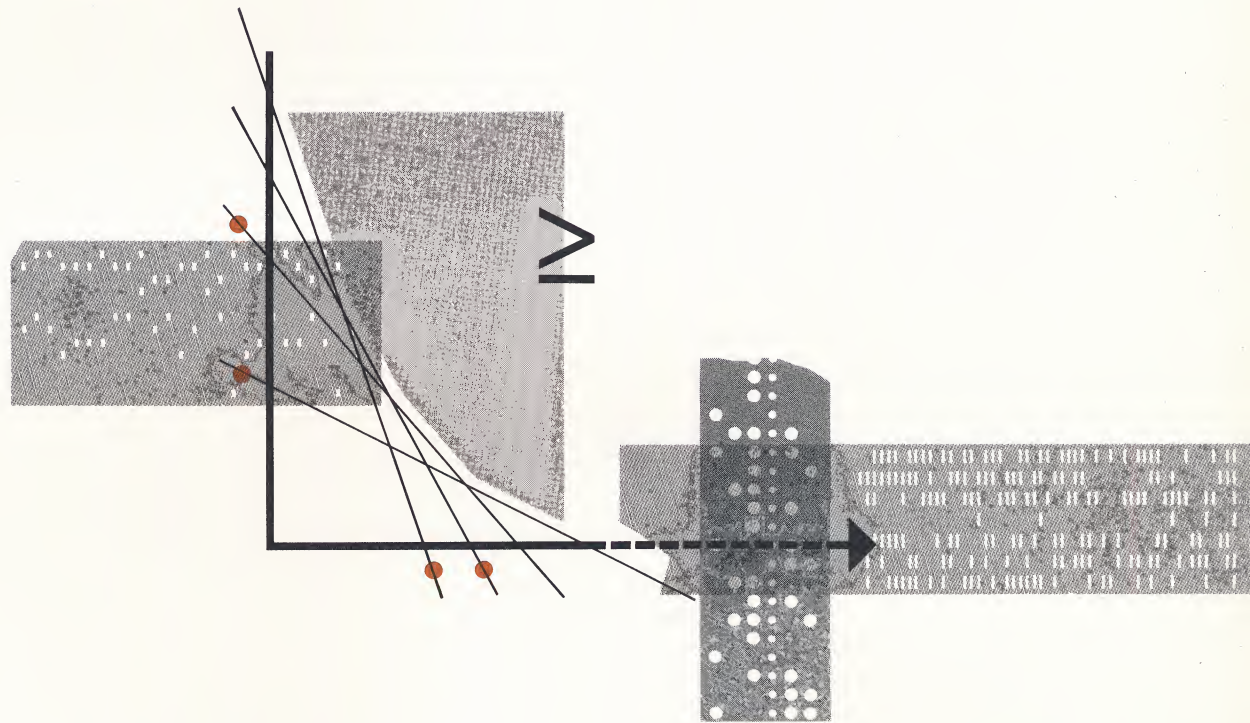
MCDONNELL AUTOMATION CENTER

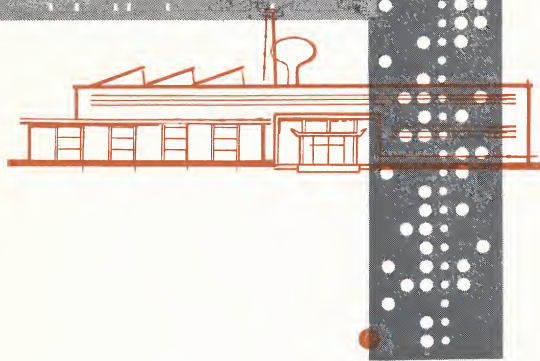
C. T. Salisbury
Manager of Marketing

CTS/ws

Enclosures

Linear Programming





LINEAR PROGRAMMING

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What can be achieved with Linear Programming?

McDonnell's Linear Programming Service is a powerful, scientific management tool:

- It develops a mathematical description or model of corporate or industrial activities.
- It provides a testing ground under laboratory conditions for proposed courses of action before actual implementation.
- It indicates the degree of interactions and interrelationships among corporate and operational activities.
- It optimizes the allocation of resources based upon actual considerations.
- It revises and manipulates the linear programming model to reflect changes in economic information.
- It obtains marginal costs which show economic incentives to relax constraints and costs.
- It determines the range over which individual costs and limits can be varied without changing the solution.
- It isolates changes in optimal solutions resulting from varying any or all costs or constraints.
- It is a practical tool for solving day-to-day operating problems.

A Manufacturer makes a number of different products, each of which uses certain production resources, and each of which is available only in limited amounts. He knows how much profit he should make from each product, but how much of each should he produce to make a maximum total profit?

He uses a large number of raw materials in the production of his products. The prices of these materials are subject to market fluctuations. In some instances, there are significant price breaks for large orders. He has a choice of which raw materials to use. One he is not using might be used more profitably if the price were lower. Which one should he be using, and how much would the price have to drop before he could make a greater profit by using it?

Such operations usually involve large sums of money, so the manufacturer needs to know which policy to follow, with the certainty that it is the best. He needs to know the effects of any changes once the best solution has been found.

A rational approach to answers requires a systematic way of representing the objectives he seeks and a systematic way of describing any possible limitations under which he may have to operate.

Linear Programming is a powerful, scientific management tool which can give this Manufacturer the answers he needs.

A FEW TYPICAL LINEAR PROGRAMMING APPLICATIONS IN BUSINESS AND INDUSTRY

Chemical Company

The optimization of a production scheduling process for a multi-plant multi-product operation based upon minimum cost and maximum profits.

Food Processor

The determination of an entire production process from the purchase of raw materials to the finished product based upon the profitability of the end item.

Gasoline Refinery

The optimization of a plant processing operation which includes distillation, catalytic cracking, reforming, and blending.

Metal Smelting Operations

The determination of the optimal mixing activities based upon minimizing the cost of raw materials put into the process.

Linear Programming can assist Management in properly allocating capital, raw materials, manpower, plant facilities, and other resources to decrease costs and increase profits.

Linear Programming is a scientific technique which selects the optimum of many possible solutions to a problem.

Steps involved in solving a problem with linear programming:

- Problem formulation.
- Computer operations.
- Interpretation of results.
- Management decision.
- Evaluation of changes.

There must be separate, identifiable activities.

These activities must be measurable in numerical terms.

These activities must be interrelated.

Restrictions must be identified.

All activities must be translated into numerical terms.



The McDonnell Automation Center possesses the rights to the most up-to-date linear programming codes available, the CEIR Corporation's LP/94 System I, an outgrowth of the LP/90, and LP/94 System II, an extension of LP/94 System I.

The LP/94 System I has many additional features and significant operating differences over the LP/90 code. Furthermore, it is 3 to 3.5 times faster in operational and computational time. Its major features are its ability to utilize **Separable Programming** and **Decomposition**.

Separable Linear Programming enables the LP/94 System I code to generate optimum solutions for problems in which some activities or functions within that problem are not linear. The LP/94 System I allows the splitting of that activity into a number of smaller

activities, each of which is linear and can therefore be solved in the usual way by the code by allowing only one or two (if adjacent) variables in the solution.

Decomposition Linear Programming is a concept in which a large problem is reduced to a number of more manageable smaller problems which can be solved more easily. The answers to these are combined to give an optimal answer to the large problem. By utilizing decomposition, the size and complexity of the problems which the code can solve are greatly extended.

When combined, Separable and Decomposition Linear Programming significantly decrease the machine time that is necessary to solve large complex problems.

The LP/94 System II code, a more recent development, is the most efficient linear programming code yet devised. It is two to three times faster than LP/94 System I. It incorporates most of the significant operating features of LP/94 System I and adds two significant concepts — **Semi-transportation** and **Bounded Variables**.

The **Semi-transportation** feature enables the solving of problems which involve transportation to or from numerous given points without having to use as many equations as previously. By incorporating the features of a transportation model directly into the code, the capacity and size of a potential linear programming problem is significantly extended.

The **Bounded Variables** feature also increases the size and dimensions of the linear programming problems the code can solve. Bounding the variables in a linear programming problem eliminates the need for writing equations to describe their limits, because the bounds placed on the variables are incorporated directly into the data specifications. In addition, the variables in the LP/94 System II code can be positive, negative, or frozen at zero, as specified by the problem formulator.

The McDonnell Automation Center has a staff experienced in the design, development, operation, and analysis of problems applicable to solving through linear programming.

The linear programming codes used by the McDonnell Automation Center are the most efficient available.

The McDonnell Automation Center's computers are among the most powerful available.

This combination enables the McDonnell Automation Center to solve linear programming problems of almost unlimited dimension and complexity.



$$2S + 4D \leq 80$$



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Applications (Administrative)

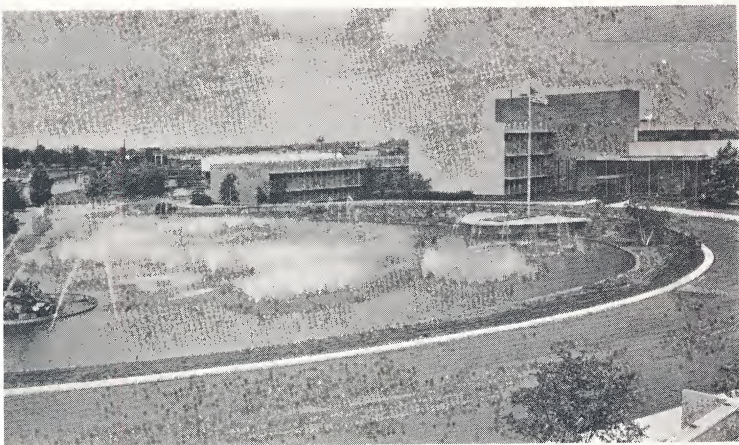
Accounting
Manufacturing
MICR Demand Deposit Accounting
Grade Reporting
School Scheduling
Payroll
Statistical Analysis
Advertising Research

Applications (Scientific)

Mathematical Programming
Numerical Control
Reliability Studies
Test Data Reduction
Stress Analysis
Linear Programming
Trajectories
Circuit Design and Analysis
Operations Research
Stochastic Simulation
Network Analysis
Framed Structures Analysis
Piping Flexibility Analysis
Load Flow Analysis

Industries

Accounting, Auditing, & Bookkeeping
Aerospace
Wholesale & Retail
Chemical
Metal Fabricating
Construction
Data Processing
Finance
Government
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